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(71)出願人　000002082
スズキ株式会社
静岡県浜松市高塚町300番地

(71)出願人　000006105
株式会社明電舎
東京都品川区大崎２丁目１番17号

(72)発明者　小俣　美昭
静岡県浜松市高塚町300番地　スズキ株式会社内

(74)代理人　100062199
弁理士　志賀　富士弥　（外１名）

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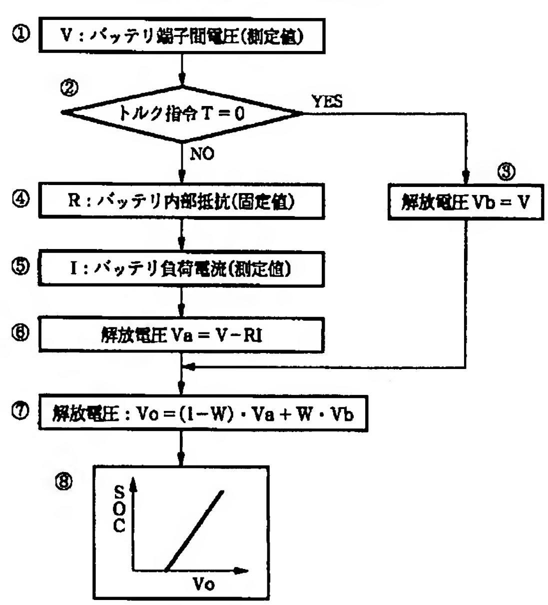
(54)【発明の名称】　バッテリ残存容量推定装置

(57)【要約】

【課題】　バッテリ解放電圧の演算誤差をなくしバッテリ残存容量（ＳＯＣ）を正確に推定する。

【解決手段】　①でバッテリ端子間電圧Ｖを測定し、②でバッテリ負荷の有無を負荷（モータ）のトルク指令から判断し、③で負荷運転時の解放電圧Ｖｂ＝Ｖを求め、⑥でバッテリの負荷運転時における解放電圧Ｖａを、バッテリの内部抵抗Ｒ、端子間電圧Ｖ、負荷電流ＩからＶａ＝Ｖ－ＲＩとして求め、⑦でＶａ，Ｖｂに重みＷをつけて、バッテリ解放電圧Ｖｏ＝（１－Ｗ）・Ｖａ＋Ｗ・Ｖｂを計算し、⑧でＶｏからＳＯＣを計算して推定する。このＳＯＣ推定では、バッテリ解放電圧Ｖｏを、電圧精度として不十分な負荷運転時の推定解放電圧Ｖａに対し、電圧精度が高い無負荷時の解放電圧Ｖｂを重み付けしてして演算処理にてバッテリの解放電圧Ｖｏを算出しているので、Ｖｏ推定精度が上り、ＳＯＣ推定精度が向上する。

SOC演算フロー(R固定値)



T：モータ制御のトルク指令値

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【特許請求の範囲】

【請求項１】　バッテリ端子間電圧とバッテリ負荷電流及びバッテリ内部抵抗からバッテリ解放電圧を推定し、この推定バッテリ解放電圧からバッテリの残存容量を推定するバッテリ残存容量推定装置において、
前記推定バッテリ解放電圧を、バッテリの無負荷運転時の解放電圧とバッテリの負荷運転時における端子電圧からバッテリ内部抵抗降下分を差し引いた負荷運転時の推定解放電圧に重みをつけて算出することを特徴とするバッテリ残存容量推定装置。

【請求項２】　請求項１において、
バッテリ残存容量一内部抵抗特性マップを設け、
前記バッテリ内部抵抗を、バッテリ残存容量－内部抵抗の特性マップを利用し、バッテリ残存容量の前回値より演算処理にて推定することを特徴とするバッテリ残存容量推定装置。

【請求項３】　請求項１において、
前記バッテリ内部抵抗を、バッテリ解放電圧が変化しないと仮定できる短時間の間における異なるバッテリ端子間電圧及びバッテリ負荷電流より演算処理にて推定することを特徴とするバッテリ残存容量推定装置。

【請求項４】　請求項１又は３においてバッテリ負荷がインバータモータの場合モータ効率とインバータ効率を含んだインバータモータの総合効率マップを設け、
前記バッテリ負荷電流を、バッテリの負荷であるインバータモータの現時点の回転数とトルク指令からモータ出力を求め、このモータ出力と前記インバータモータの総合効率マップから導かれる効率によってバッテリ出力電力を求め、このバッテリ出力電力とバッテリ端子間電圧からバッテリ負荷電流を算出することを特徴とするバッテリ残存容量推定装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】この発明は、電気自動車やハイブリッド電気自動車等のバッテリをエネルギー源としてモータを駆動するシステムにおける、バッテリの残存容量を推定するバッテリ残存容量推定装置に関する。

【０００２】

【従来の技術】一般に、バッテリの残存容量（ＳＯＣ）は、バッテリの解放電圧と密接な関係を持っており、解放電圧からＳＯＣを推定することが可能である。

【０００３】負荷時にバッテリの解放電圧は直接推定できないが、バッテリ端子間電圧とバッテリ内部抵抗（固定値）とバッテリ負荷電流（放電電流又は充電電流）によって算出でき、この値よりＳＯＣが推定可能である。このＳＯＣ推定の演算フローを図５に示す。

【０００４】通電中の電圧、電流の推定データから解放電圧を推定し、ＳＯＣを推定する装置の一例を図６に示す。この装置は、バッテリＰＢの負荷電流を検出しＡ／Ｄ変換した実測電流データＩｊから第一演算回路１４でバッテリ端子間電圧Ｖｊ′を推定し、バッテリ電圧を検出しＡ／Ｄ変換した実測端子間電圧データＶｊと上記推定端子間電圧Ｖｊ′との差ｅｊを比較回路１５で演算し、第１演算回路１４で前記差ｅｊに基づき推定端子間電圧Ｖｊ′を実測端子間電圧に近似させるべく前記差ｅｊをフィードバックさせながら第１演算回路１４における第１関係式の関数項の変更と演算をｅｊ＝０となるまで繰り返し、定数分Ｃｊを推定解放電圧として出力し、第二演算回路２１で推定解放電圧に基づいてＳＯＣを演算している。（特開平５－１４２３１４）

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【０００５】

【発明が解決しようとする課題】ところで、バッテリ内部抵抗ＲはＳＯＣの値に関連して逐次変化するため正確なＳＯＣを推定することは困難である。また、バッテリから負荷電流（放電電流、充電電流）を推定するため、ホールＣＴなどの電流検出装置を取り付ける必要があり、コスト高になる。

【０００６】この発明は、上記課題を解決すべくなされたものであり、その目的とするところは、前回ＳＯＣの値に基づいたバッテリ内部抵抗を求め無負荷運転時と負荷運転時の推定解放電圧に重みをつけて精度を上げた、開放電圧からＳＯＣを正確に推定しうるようにしたバッテリ残存容量推定装置を提供することにある。

【０００７】

【課題を解決するための手段】この発明は、バッテリ端子間電圧とバッテリ負荷電流及びバッテリ内部抵抗からバッテリ解放電圧を推定し、この推定バッテリ解放電圧からバッテリの残存容量を推定するバッテリ残存容量推定装置において、前記推定バッテリ解放電圧を、バッテリの無負荷運転時の解放電圧とバッテリの負荷運転時における端子電圧からバッテリ内部抵抗降下分を差し引いた負荷運転時の推定解放電圧に重みをつけて算出することを特徴とする。

【０００８】前記バッテリ内部抵抗は、バッテリ残存容量－内部抵抗の特性マップ設け、この特性マップを利用しバッテリ残存容量の前回値より演算により推定、または、バッテリ解放電圧が変化しないと仮定できる短時間の前後時点におけるバッテリ端子間電圧及びバッテリ負荷電流を用いて計算より推定するとよい。

【０００９】また、バッテリ一負荷がインバータモータの場合、モータ効率とインバータ効率を含んだインバータモータの総合効率マップを設け、前記バッテリ負荷電流は、バッテリの負荷であるインバータモータの現時点の回転数とトルク指令からモータ出力を求め、このモータ出力と前記インバータモータの総合効率マップから導かれる効率によってバッテリ出力電力を求め、このバッテリ出力電力とバッテリ端子間電圧からバッテリ負荷電流を計算により推定するとよい。

【００１０】

【発明の実施の形態】実施の形態１

電気自動車やハイブリット電気自動車は通常走行時にモータのトルク指令をゼロにする場合が多々ある。トルク指令がゼロの時はバッテリ電流がゼロとなるためバッテリ解放電圧は端子電圧と等しくなり正確なバッテリ残存容量（ＳＯＣ）が推定できる。

【００１１】実施の形態１は図１に示すように従来図５に示したＳＯＣ推定の計算フローに、トルク指令値がゼロの場合の条件を付加し、更に重み付けを行ないＳＯＣを推定する。　ＳＯＣ推定装置は、バッテリ端子間電圧及びバッテリ負荷電流を検出する電圧、電流検出器と、検出した電圧、電流信号をディジタル信号に変換するＡ／Ｄ変換器と、この電圧、電流データを用いてＳＯＣ推定をするＣＰＵ等からなる演算部で構成されている（図示省略）。

【００１２】図１について、上記ＳＯＣ推定装置演算部におけるＳＯＣ推定の演算処理手順を説明する。

【００１３】まず、ステップ①でＣＰＵはＡ／Ｄ変換器を介してバッテリ端子間電圧Ｖを測定し、②でバッテリで駆動されるモータのトルク指令Ｔがゼロであるか否かを判断する。この判断結果がＹＥＳ（Ｔ＝０）の場合は、③で解放電圧Ｖｂにバッテリ端子間電圧Ｖを代入する。ＮＯ（Ｔ≠０）の場合は、④、⑤でバッテリ内部抵抗Ｒ（固定値）とバッテリ負荷電流Ｉを取り込み、⑥で解放電圧Ｖａ＝Ｖ－ＲＩを算出する。

【００１４】⑦で解放電圧Ｖａ，Ｖｂに重み付けをして解放電圧Ｖｏ＝（１－Ｗ）・Ｖａ＋Ｗ・Ｖｂを算出する。重みＷ付けにより計算による負荷運転時の解放電圧Ｖａを重視するか、無負荷運転時の解放電圧Ｖｂを重視するかを任意に設定できる。（Ｗ＝０の時：Ｖｏ＝Ｖａ、Ｗ＝１の時Ｖｏ＝Ｖｂ）。そして⑧で解放電圧ＶｏよりＳＯＣを計算してＳＯＣを推定する。

【００１５】上記実施の形態１によれば、上記従来図５のＳＯＣ推定方式にトルク指令Ｔがゼロの場合の条件を付加し、負荷時と無負荷時の解放電圧に重み付けを行なってＳＯＣを推定しているので、ＳＯＣ推定の精度が向上する。

＊【００１６】実施の形態２

バッテリ内部抵抗Ｒは放電時と充電時各々についてバッテリの残存容量（ＳＯＣ）の関数になっていることがわかっている。

【００１７】実施の形態２は図２に示すように、上記図１の⑥の解放電圧Ｖａの計算に使用する④のバッテリ内部抵抗Ｒ（固定値）を推定値に代えてとして図１の場合と同様にＳＯＣを推定する。

【００１８】上記図２④のバッテリ内部抵抗Ｒ推定の演算処理手順を図３について説明する。予めバッテリの充電時と放電時それぞれについてＳＯＣに対する内部抵抗ＲのマップＡ，Ｂを用意し、図２の②におけるトルク指令が０か否かの判断結果がＮＯの場合、ステップ４１でトルク指令Ｔがゼロより大きいか否かの判断をする。この判断結果がＹＥＳ（放電時）の場合、４２でマップＡにより前回推定のＳＯＣ値からバッテリ内部抵抗Ｒを推定し、ＮＯ（充電時）の場合、４３でマップＢにより前回推定のＳＯＣ値からバッテリ内部抵抗Ｒを推定する。

【００１９】上記実施の形態２によれば、バッテリ内部抵抗Ｒを推定して解放電圧Ｖａを計算しているので、ＳＯＣの推定精度が上記図１の場合より向上する。

【００２０】実施の形態３

実施の形態３では実施の形態２と同様に図２のＳＯＣ推定の計算フローでＳＯＣを推定するが、④のバッテリ内部抵抗Ｒの推定はバッテリの端子間電圧Ｖと負荷電流Ｉを用いて計算により推定する。

【００２１】実施の形態３にかかるバッテリ内部抵抗の推定方法について説明する。バッテリの解放電圧Ｖｏと端子電圧Ｖと内部抵抗Ｒの関係を（１）式に示す。

【００２２】Ｖｏ＝Ｖ－Ｒ・Ｉ…（１）

ここで、短時間と仮定するとバッテリ解放電圧Ｖｏが変化せず、ＳＯＣも変化しないため、この短時間の間に異なる２つの負荷条件時の電圧、電流データを検出すれば、（２）（３）式より（４）式が成立し、（５）式よりバッテリ内部抵抗Ｒを推定することが可能となる。

＊【００２３】

Ｖｏ＝Ｖ１－Ｒ・Ｉ１…（２）

Ｖｏ＝Ｖ２－Ｒ・Ｉ２…（３）

（２）－（３）より　Ｖ１－Ｖ２＝Ｒ・（Ｉ１－Ｉ２）…（４）

従って、内部抵抗推定値Ｒは、Ｒ＝（Ｖ１－Ｖ２）／（Ｉ１－Ｉ２）…（５）

ただし、Ｖ１，Ｖ２はバッテリ端子間電圧で測定値

Ｉ１，Ｉ２はバッテリの負荷電流で測定値

実施の形態３によれば、図２の計算フローにおける④のバッテリ内部抵抗Ｒの推定を（５）式により簡単に行なうことができる。

【００２４】実施の形態４

上記図１のＳＯＣ推定の演算フローにおける⑤のバッテリ負荷電流Ｉ（測定値）は、ホールＣＴなどで検出している。実施の形態４は、負荷がインバータモータの場合、図１の⑤の負荷電流Ｉを測定する代りに電圧ＶＤＣ※（＝バッテリ電圧Ｖ）（測定値）とモータ回転数ω（測定値）及びトルク指令Ｔを用いて演算により負荷電流Ｉを推定する。

【００２５】上記負荷電流Ｉ推定の演算処理手順を図４について説明する。予めトルク指令Ｔとモータ回転数ωに対するモータ効率とインバータ効率を含んだインバータモータの総合効率ηのマップＣを用意しておく。

【００２６】図１②のトルク指令Ｔがゼロか否かの判断結果がＮＯの場合、５１で直流電圧ＶＤＣ（測定値）、モータ回転数ω（測定値）及びトルク指令Ｔを取り込

み、５２でインバータモータの総合効率マップＣを用いて現時点のモータ回転数ωとトルク指令から総合効率ηを求め、５３で現時点のモータ回転数ωとトルク指令から導かれるモータ出力ωＴと総合効率ηからバッテリ出力Ｐ＝ωＴ／ηを求め、５４でバッテリ出力Ｐと直流電圧ＶＤＣからバッテリ負荷電流Ｉ＝Ｐ／ＶＤＣを算出する。

【００２７】電気自動車やハイブリッド電気自動車等では、モータ回転数を測定している。実施の形態４はこのモータ回転数を利用してバッテリ負荷電流を推定するので、ホールＣＴ等のバッテリ負荷電流検出器が不要となり、コスト的に有利となる。なお、この負荷電流算出方法は図２の⑤にも適用できる。

【００２８】実施の形態５

実施の形態５は、実施の形態３の装置において、図２の計算フロー⑤のバッテリ負荷電流Ｉ（測定値）を測定せずに、実施の形態４と同様にバッテリ負荷電流を推定してＳＯＣの推定を行なう。

【００２９】即ち、図２の演算フローにおいて、④のバッテリ内部抵抗Ｒ（測定値）を上記（５）式により推定し、⑤のバッテリ負荷電流Ｉ（測定値）を図４に示すように、トルク指令Ｔとモータ回転数ωに対するモータ効率とインバータ効率を含んだインバータモータの総合効率マップＣからインバータモータの総合効率ηを求めてバッテリ出力Ｐ＝ωＴ／ηを求め、バッテリ出力Ｐと直流電圧Ｖ（測定値）からバッテリ負荷電流Ｉ＝Ｐ／ＶＤＣを推定し、バッテリ端子電圧（測定値）と推定したバッテリ内部抵抗Ｒ及びバッテリ負荷電流から⑦の解放電圧Ｖｏ＝（１－Ｗ）・Ｖａ＋Ｗ・Ｖｂを求め、⑧で解放電圧ＶｏからＳＯＣを計算により推定する。

【００３０】上記実施の形態５によれば、バッテリ負荷電流を推定しているのでホールＣＴ等を必要とせず、実施の形態３に比較してコスト的に有利となる。

【００３１】

【発明の効果】この発明は、上述のとおり構成されているので、以下に記載する効果を奏する。

（１）電圧精度として不十分な負荷運転時のバッテリの推定解放電圧に対し、電圧精度が高い無負荷運転時の解放電圧を重み付けで計算処理しているので、バッテリの解放電圧の演算精度が上がり、ＳＯＣの推定精度が向上する。

（２）バッテリの内部抵抗は放電時と充電時についてＳＯＣの関数となっているので、ＳＯＣ－バッテリ内部抵抗の特性マップを利用しＳＯＣの前回値よりバッテリ内部抵抗を推定した場合ＳＯＣ推定精度が向上する。

（３）バッテリ解放電圧が変化しないと仮定することができる、短時間の間の異なるバッテリ端子電圧、電流からバッテリ内部抵抗を推定した場合、比較的簡単な演算でバッテリ内部抵抗を推定することができる。

（４）バッテリ負荷電流を推定している場合、ホールＣＴなどのバッテリ電流検出器を必要としないので、コスト的に有利となる。

【図面の簡単な説明】

【図１】この発明の実施の形態１にかかるＳＯＣ推定装置のＳＯＣ演算フロー図。

【図２】この発明の実施の形態２にかかるＳＯＣ推定装置のＳＯＣ演算フロー図。

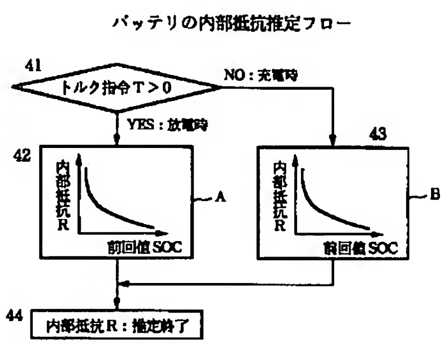
【図３】同装置のバッテリの内部抵抗推定フロー図。

【図４】この発明の実施の形態４にかかるＳＯＣ推定装置のバッテリ負荷電流演算フロー図。

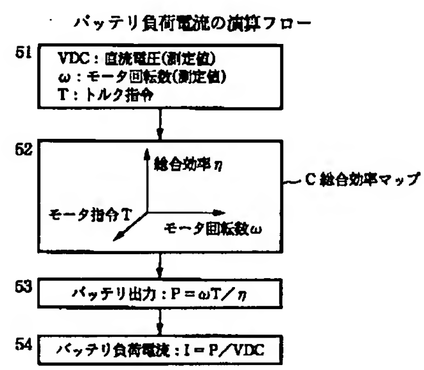
【図５】従来例にかかるＳＯＣ推定装置のＳＯＣ演計算フロー図。

【図６】他の従来例にかかるＳＯＣ推定装置を示すブロック図。

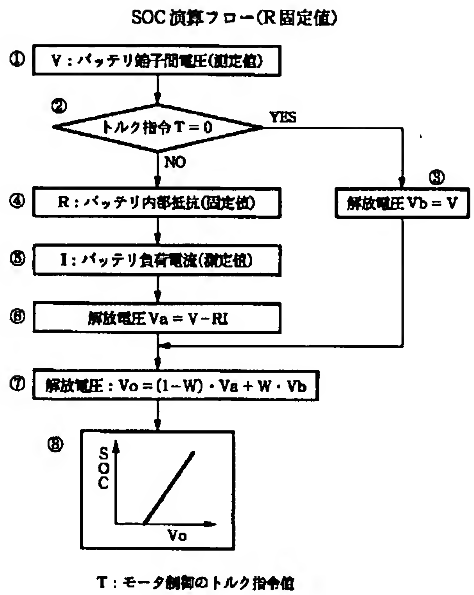
【図３】



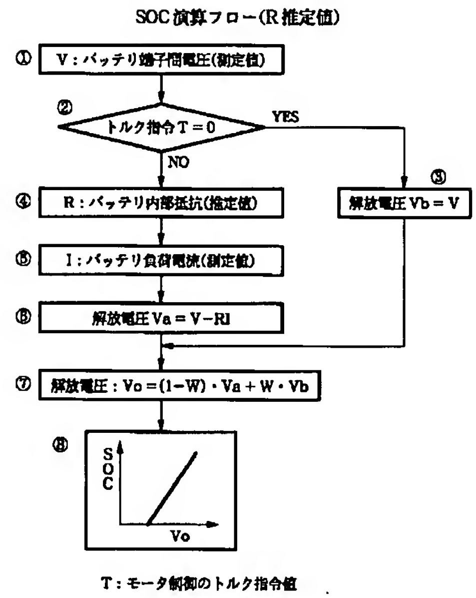
【図４】



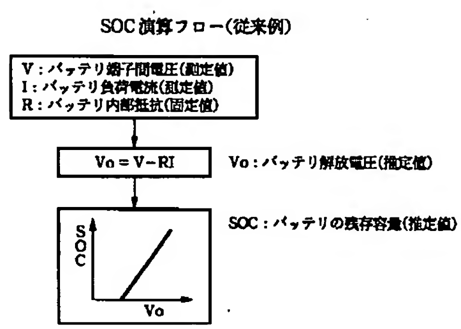
【図1】


SOC演算フロー(R固定値)
①
V：バッテリ端子間電圧(測定値)
②
トルク指令T＝0
YES
NO
③
解放電圧Vb＝V
④
R：バッテリ内部抵抗(固定値)
⑤
I：バッテリ負荷電流(測定値)
⑥
解放電圧Va＝V－RI
⑦
解放電圧：Vo＝(1－W)・Va＋W・Vb
⑧
SOC
Vo
T：モータ制御のトルク指令値

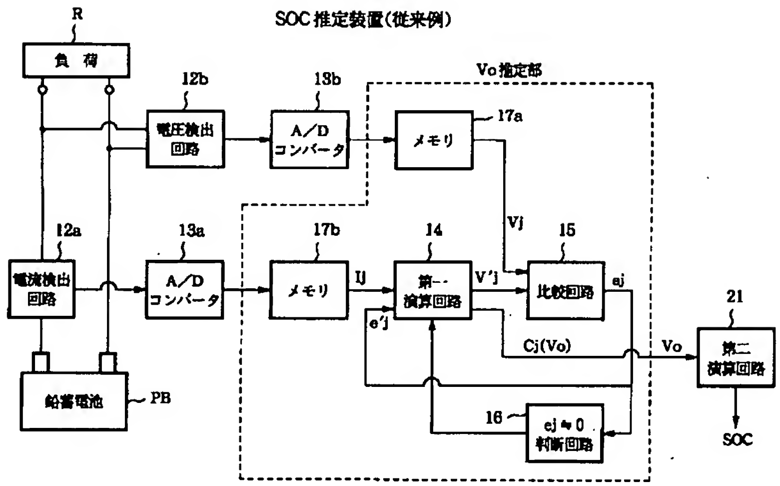
【図2】


SOC演算フロー(R推定値)
①
V：バッテリ端子間電圧(測定値)
②
トルク指令T＝0
YES
NO
③
解放電圧Vb＝V
④
R：バッテリ内部抵抗(推定値)
⑤
I：バッテリ負荷電流(測定値)
⑥
解放電圧Va＝V－RI
⑦
解放電圧：Vo＝(1－W)・Va＋W・Vb
⑧
SOC
Vo
T：モータ制御のトルク指令値

【図5】


SOC演算フロー(従来例)
V：バッテリ端子間電圧(測定値)
I：バッテリ負荷電流(測定値)
R：バッテリ内部抵抗(固定値)
Vo＝V－RI
Vo：バッテリ解放電圧(推定値)
SOC：バッテリの残存容量(推定値)
SOC
Vo

【図6】



フロントページの続き

(72)発明者　杉山　英生
静岡県浜松市高塚町300番地　スズキ株式会社内

(72)発明者　中野　義則
東京都品川区大崎２丁目１番17号　株式会社明電舎内

(72)発明者　足利　正
東京都品川区大崎２丁目１番17号　株式会社明電舎内

(72)発明者　野坂　克紀
東京都品川区大崎２丁目１番17号　株式会社明電舎内

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(71)Applicant : SUZUKI MOTOR CORP
MEIDENSHA CORP

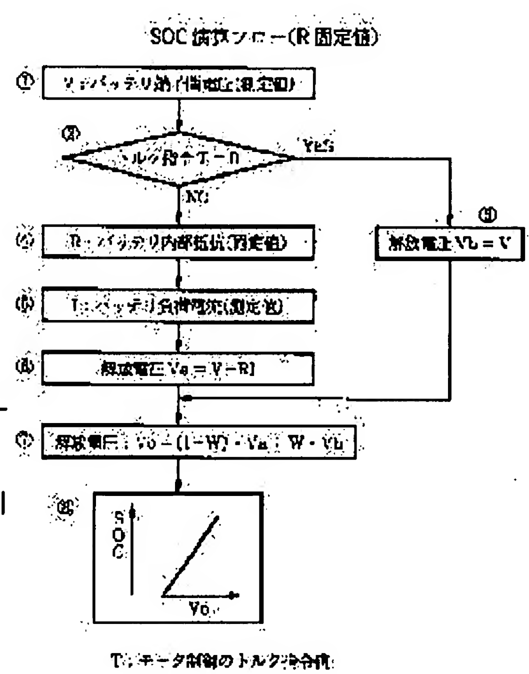
(72)Inventor : KOMATA YOSHIAKI
SUGIYAMA HIDEO
NAKANO YOSHINORI
ASHIKAGA TADASHI
NOSAKA KATSUNORI

(54) ESTIMATION DEVICE FOR BATTERY RESIDUAL CAPACITY

(57)Abstract:

PROBLEM TO BE SOLVED: To precisely estimate a battery residual capacity (SOC) by eliminating the computing error of a battery open-circuit voltage.

SOLUTION: A battery interterminal voltage V is measured in (1). The existence of a battery load is judged on the basis of the torque command of a load (a motor) in (2). An open-circuit voltage Vb=V at a time when the load is operated is found in (3). In (6), an open-circuit voltage Va at a time when the battery load is operated is found as Va=V-RI on the basis of the internal resistance R, the interterminal voltage V and the load current I of a battery. In (7), the voltage Va and the voltage Vb are weighted W, and a battery open- circuit voltage Vo=(1-W).Va+W.Vb is calculated. In (8), the battery residual capacity SOC is calculated on the basis of the open-circuit voltage Vo so as to be estimated. When the residual capacity SOC is estimated, the open-circuit voltage Vb in a no-load state whose voltage accuracy is high is weighted with reference to the estimated



open-circuit voltage at a time when the load whose voltage accuracy is insufficient is operated, and the battery open-circuit voltage Vo is calculated. As a result, the estimation accuracy of the open-circuit voltage Vo is increased, and the estimation accuracy of the residual capacity SOC is enhanced.

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[Date of extinction of right]	

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the dc-battery remaining capacity presumption equipment in the system which drives a motor by making dc-batteries, such as an electric vehicle and a hybrid electric vehicle, into an energy source which presumes the remaining capacity of a dc-battery.

[0002]

[Description of the Prior Art] Generally, the remaining capacity (SOC) of a dc-battery has close relation with the release electrical potential difference of a dc-battery, and it is possible to presume SOC from a release electrical potential difference.

[0003] Although the release electrical potential difference of a dc-battery cannot carry out direct presumption at the time of a load, it can compute according to the electrical potential difference between dc-battery terminals, dc-battery internal resistance (fixed value), and the dc-battery load current (discharge current or charging current), and SOC can be presumed from this value. The operation flow of this SOC presumption is shown in drawing 5 .

[0004] An example of equipment which presumes a release electrical potential difference from the electrical potential difference under energization and the presumed data of a current, and presumes SOC is shown in drawing 6 . This equipment presumes electrical-potential-difference Vjbetween dc-battery terminals ' in the first arithmetic circuit 14 from the observation current data Ij which detected and carried out A/D conversion of the load current of Dc-battery PB. The difference ej of the electrical-potential-difference data Vj between observation terminals which detected and carried out A/D conversion of the battery voltage, and above-mentioned electrical-potential-difference Vjbetween presumed terminals ' is calculated in a comparator circuit 15. Making said difference ej feed back in order to make electrical-potential-difference Vjbetween presumed terminals ' approximate to the electrical potential difference between observation terminals in the 1st arithmetic circuit 14 based on said difference ej, modification and the operation of a function term of the 1st relational expression in the 1st arithmetic circuit 14 are repeated until it is set to ej=0. A part for a constant Cj is outputted as a presumed release electrical potential difference, and SOC is calculated in the second arithmetic circuit 21 based on a presumed release electrical potential difference. (JP,5-142314,A)

[0005]

[Problem(s) to be Solved by the Invention] By the way, since the dc-battery internal resistance R changes serially in relation to the value of SOC, it is difficult the internal

resistance to presume exact SOC. Moreover, in order to presume the load current (discharge current, charging current) from a dc-battery, it is necessary to attach current detection equipments, such as Hole CT, and becomes cost quantity.
[0006] The place which it is made that the above-mentioned technical problem should be solved, and is made into that purpose has this invention in offering the dc-battery remaining capacity presumption equipment which gave weight to the presumed release electrical potential difference at the time of no-load running and load operation in quest of the dc-battery internal resistance based on the value of SOC last time, and raised precision and which enabled it to presume SOC correctly from open circuit voltage.
[0007]
[Means for Solving the Problem] It carries out that set this invention to the dc-battery remaining-capacity presumption equipment which presumes a dc-battery release electrical potential difference from the electrical potential difference between dc-battery terminals, the dc-battery load current, and dc-battery internal resistance, and presumes the remaining capacity of a dc-battery from this presumed dc-battery release electrical potential difference, and it gives and computes weight on the presumed release electrical potential difference at the time of load operation which deducted a part for dc-battery internal-resistance descent from the release electrical potential difference at the time of no-load running of a dc-battery and the terminal voltage at the time of load operation of a dc-battery as the description. [electrical potential difference / said / presumed dc-battery release]
[0008] Said dc-battery internal resistance is good to presume from count using the electrical potential difference between dc-battery terminals and the dc-battery load current at the time before and after the short time which can be assumed that property map **** of dc-battery remaining capacity-internal resistance and this property map are used, and presumption or a dc-battery release electrical potential difference does not change with operations from the last value of dc-battery remaining capacity.
[0009] Moreover, when a dc-battery load is an inverter motor, the overall-efficiency map of an inverter motor including a motor efficiency and inverter effectiveness is prepared, and said dc-battery load current is good to ask for a motor output from the engine speed of the inverter motor which is the load of a dc-battery at present, and a torque command, to ask for dc-battery output power with the effectiveness drawn from the overall-efficiency map of this motor output and said inverter motor, and to presume the dc-battery load current by count from this dc-battery output power and the electrical potential difference between dc-battery terminals.
[0010]
[Embodiment of the Invention] Gestalt 1 electric vehicle and the high Brit electric vehicle of operation usually have plentifully the case where the torque command of a motor is made into zero, at the time of transit. Since a dc-battery current serves as zero when a torque command is zero, a dc-battery release electrical potential difference becomes equal to terminal voltage, and can presume exact dc-battery remaining capacity (SOC).
[0011] The gestalt 1 of operation adds conditions in case a torque command value is zero to the count flow of SOC presumption conventionally shown in <u>drawing 5</u> , as shown in <u>drawing 1</u> , it performs weighting further, and presumes SOC. SOC presumption equipment consists of operation part which consists of the electrical potential difference which detects the electrical potential difference between dc-battery terminals, and the dc-

battery load current, a current detector, the detected electrical potential difference and the A/D converter which changes a current signal into a digital signal, a CPU that carries out SOC presumption using this electrical potential difference and current data (illustration abbreviation).

[0012] About drawing 1 , the data-processing procedure of SOC presumption in the above-mentioned SOC presumption equipment operation part is explained.

[0013] First, it judges whether the torque command T of the motor which CPU measures the electrical potential difference V between dc-battery terminals through an A/D converter by step **, and is driven with a dc-battery by ** is zero. When this decision result is YES (T= 0), the electrical potential difference V between dc-battery terminals is substituted for the release electrical potential difference Vb by **. In NO (T!=0), the dc-battery internal resistance R (fixed value) and the dc-battery load current I are incorporated by ** and **, and it computes release electrical-potential-difference Va=V-RI by **.

[0014] ** Compute release electrical-potential-difference Vo= (1-W) and Va+W-Vb by making weighting the release electrical potential differences Va and Vb. It can set it as arbitration whether the release electrical potential difference Va at the time of load operation by count is thought as important by weight W attachment, or the release electrical potential difference Vb at the time of no-load running is thought as important. (At the time of W= 0: At Vo=Va, the time of W= 1 Vo=Vb) . And SOC is calculated from the release electrical potential difference Vo by **, and SOC is presumed.

[0015] Since according to the gestalt 1 of the above-mentioned implementation conditions in case the torque command T is zero were added to the SOC presumption method of drawing 5 conventionally [above-mentioned], weighting was performed on the release electrical potential difference at the time of a load and no-load and SOC is presumed, the precision of SOC presumption improves.

[0016] It turns out that the gestalt 2 dc-battery internal resistance R of operation is the function of the remaining capacity (SOC) of a dc-battery about each at the time of discharge and charge.

[0017] the dc-battery internal resistance R of ** used for count of the release electrical potential difference Va of ** of above-mentioned drawing 1 as the gestalt 2 of operation is shown in drawing 2 (fixed value) -- estimate -- replacing with -- ** -- it carries out and SOC is presumed like the case of drawing 1 .

[0018] The data-processing procedure of dc-battery internal resistance R presumption of the above-mentioned drawing 2 ** is explained about drawing 3 . The maps A and B of internal resistance R to SOC are beforehand prepared about each at the time of charge of a dc-battery, and discharge, and when the torque command in ** of drawing 2 is [the decision result of being 0] NO, it judges whether the torque command T is larger than zero at step 41. When this decision result is YES (at the time of discharge), the dc-battery internal resistance R is presumed from a presumed SOC value last time on Map A by 42, and, in NO (at the time of charge), the dc-battery internal resistance R is presumed from a presumed SOC value last time on Map B by 43.

[0019] Since the release electrical potential difference Va is calculated by having presumed the dc-battery internal resistance R according to the gestalt 2 of the above-mentioned implementation, it improves from the case where the presumed precision of SOC is above-mentioned drawing 1 .

[0020] Although SOC is presumed by the count flow of SOC presumption of drawing 2 like the gestalt 2 of operation with the gestalt 3 of gestalt 3 implementation of operation, presumption of the dc-battery internal resistance R of ** is presumed by count using the electrical potential difference V between terminals and the load current I of a dc-battery.
[0021] The presumed approach of the dc-battery internal resistance concerning the gestalt 3 of operation is explained. The relation of the release electrical potential difference Vo, the terminal voltage V, and internal resistance R of a dc-battery is shown in (1) type.
[0022] Vo=V=RandI -- (1)
If it assumes that it is a short time and the electrical potential difference at the time of two different load conditions between this short time and current data will be detected here since the dc-battery release electrical potential difference Vo does not change and SOC does not change, either, (4) types will be materialized and it will become more possible than (5) types from (2) and (3) type to presume the dc-battery internal resistance R.
[0023]
Vo=V1-R-I1 -- (2)
Vo=V2-R-I2 -- (3)
(2) - (3) V1-V2=R-·(I1-I2) -- (4)
Therefore, the internal resistance estimate R is R=(V1-V2)/(I1-I2). -- (5)
However, according to the gestalt 3 of the measured-value operation by the load current of a dc-battery in measured value I1 and I2, V1 and V2 can presume dc-battery internal resistance R of ** in the count flow of drawing 2 easily by (5) types on the electrical potential difference between dc-battery terminals.
[0024] The dc-battery load current I of ** in the operation flow of SOC presumption of gestalt 4 above-mentioned drawing 1 of operation (measured value) is detected in Hole CT etc. When a load is an inverter motor, instead of measuring the load current I of ** of drawing 1 , an electrical potential difference VDC (= battery voltage V) (measured value), the motor rotational frequency omega (measured value), and the torque command T are used for the gestalt 4 of operation, and it presumes the load current I by the operation.
[0025] The data-processing procedure of the above-mentioned load current I presumption is explained about drawing 4 . The map C of the overall efficiency eta of the inverter motor which included the torque command T, the motor efficiency to the motor engine speed omega, and inverter effectiveness beforehand is prepared.
[0026] When the torque command T of drawing 1 ** is NO, the decision result of being zero by 51 Direct current voltage VDC (measured value) Incorporate the motor engine speed omega (measured value) and the torque command T, and overall efficiency eta is searched for from the motor engine speed omega at present and a torque command using the overall-efficiency map C of an inverter motor by 52. It asks for dc-battery output P=omega T/eta from the motor engine speed omega at present by 53, motor output omegaT drawn from a torque command, and overall efficiency eta, and dc-battery load current I=P/VDC is computed from the dc-battery output P and direct current voltage VDC by 54.
[0027] The motor rotational frequency is measured in the electric vehicle or the hybrid electric vehicle. Since the gestalt 4 of operation presumes the dc-battery load current using this motor engine speed, dc-battery load current detectors, such as Hole CT, become unnecessary, and it becomes advantageous in cost. In addition, this load current

calculation approach is applicable also to ** of drawing 2 .
[0028] In the equipment of the gestalt 3 of operation, without measuring the dc-battery load current I of count flow ** of drawing 2 (measured value), the gestalt 5 of gestalt 5 implementation of operation presumes the dc-battery load current as well as the gestalt 4 of operation, and presumes SOC.
[0029] Namely, as the dc-battery internal resistance R of ** (measured value) is presumed by the above-mentioned (5) formula and is shown in drawing 4 in the operation flow of drawing 2 , the dc-battery load current I of ** (measured value) In quest of the overall efficiency eta of an inverter motor, it asks for dc-battery output P=omega T/eta from the overall-efficiency map C of an inverter motor including the torque command T, the motor efficiency to the motor engine speed omega, and inverter effectiveness. Dc-battery load current I=P/VDC is presumed from the dc-battery output P and direct current voltage V (measured value). Release electrical-potential-difference Vo= (1-W) and Va+W-Vb of ** are calculated from the dc-battery internal resistance R presumed to be dc-battery terminal voltage (measured value) and the dc-battery load current, and SOC is presumed by count from the release electrical potential difference Vo by **.
[0030] According to the gestalt 5 of the above-mentioned implementation, since the dc-battery load current is presumed, Hole CT etc. is not needed, but as compared with the gestalt 3 of operation, it becomes advantageous in cost.
[0031]
[Effect of the Invention] Since this invention is constituted as above-mentioned, it does so the effectiveness indicated below.
(1) Since computation of the release electrical potential difference at the time of no-load running with a high electrical-potential-difference precision is carried out by weighting to the presumed release electrical potential difference of the dc-battery at the time of load operation inadequate as an electrical-potential-difference precision, the operation precision of the release electrical potential difference of a dc-battery goes up, and the presumed precision of SOC improves.
(2) Since the internal resistance of a dc-battery serves as a function of SOC about the time of discharge and charge, when the property map of SOC-dc-battery internal resistance is used and dc-battery internal resistance is presumed from the last value of SOC, SOC presumption precision improves.
(3) When dc-battery internal resistance is presumed from the dc-battery terminal voltage from which it differs between the short time which can be assumed that a dc-battery release electrical potential difference does not change, and a current, dc-battery internal resistance can be presumed by the comparatively easy operation.
(4) Since dc-battery current detectors, such as Hole CT, are not needed when the dc-battery load current is presumed, it becomes advantageous in cost.

[Translation done.]

CLAIMS

[Claim(s)]

[Claim 1] The dc-battery remaining-capacity presumption equipment characterized by to set to the dc-battery remaining-capacity presumption equipment which presumes a dc-battery release electrical potential difference from the electrical potential difference between dc-battery terminals, the dc-battery load current, and dc-battery internal resistance, and presumes the remaining capacity of a dc-battery from this presumed dc-battery release electrical potential difference, and to give and compute weight on the presumed release electrical potential difference at the time of load operation which deducted a part for dc-battery internal-resistance descent from the release electrical potential difference at the time of no-load running of a dc-battery and the terminal voltage at the time of load operation of a dc-battery. [electrical potential difference / said / presumed dc-battery release]

[Claim 2] Dc-battery remaining capacity presumption equipment characterized by preparing a dc-battery remaining capacity-internal resistance property map, using said dc-battery internal resistance and presuming the property map of dc-battery remaining capacity-internal resistance for it in data processing from the last value of dc-battery remaining capacity in claim 1.

[Claim 3] Dc-battery remaining capacity presumption equipment characterized by what is presumed in data processing from the different electrical potential difference between dc-battery terminals and the different dc-battery load current between the short time which can assume said dc-battery internal resistance that a dc-battery release electrical potential difference does not change in claim 1.

[Claim 4] The dc-battery remaining-capacity presumption equipment characterized by to prepare the overall-efficiency map of an inverter motor including a motor efficiency and inverter effectiveness when a dc-battery load is an inverter motor in claim 1 or 3, to ask for a motor output from the engine speed of the inverter motor which is the load of a dc-battery about said dc-battery load current at present, and a torque command, to ask for dc-battery output power with the effectiveness drawn from the overall-efficiency map of this motor output and said inverter motor, and to compute the dc-battery load current from this dc-battery output power and the electrical potential difference between dc-battery terminals.

[Translation done.]